

Gust Load Estimation and Rejection With Application to Robust Flight Control Design for HALE Aircraft, Phase I

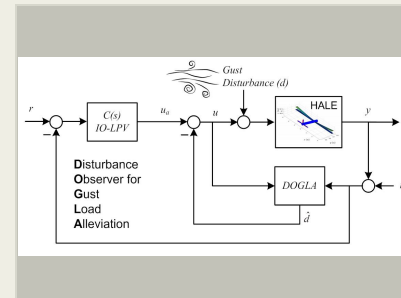
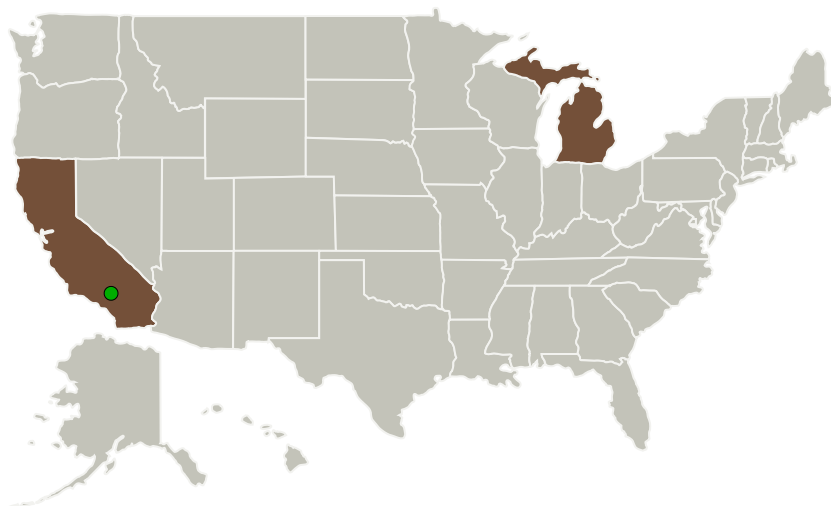
Completed Technology Project (2015 - 2016)



Project Introduction

High Altitude Long Endurance (HALE) aircraft have garnered increased interest in recent years as they can serve several purposes, including many of the objectives of satellites while incurring a fraction of the cost to deploy. Examples applications include Intelligence, Surveillance, and Reconnaissance, communications relay systems, and environmental and atmospheric sensing. The requirements for HALE aircraft dictate that they have very high lift-to-drag ratios, and are extremely lightweight, resulting in high aspect ratios with significant structural flexibility. This results in a dynamically nonlinear vehicle with highly coupled rigid body and aeroelastic structural dynamics. Atmospheric turbulence and gust loading of substantial variance can significantly impact the performance of HALE aircraft. Due to the vast importance of gust loading on these lightweight aircraft platforms, Systems Technology, Inc. and the University of Michigan propose the development of the Disturbance Observer for Gust Load Alleviation (DOGLA) where the gust loading will be actively estimated and subsequently rejected. DOGLA will be implemented on a nonlinear HALE aircraft model in conjunction with a robust primary flight control design. Both the disturbance observer and primary flight control designs will be implemented within a novel gain-scheduling framework to address nonlinear dynamics and varying flight conditions.

Primary U.S. Work Locations and Key Partners



Gust load estimation and rejection with application to robust flight control design for HALE aircraft, Phase I

Table of Contents

| | |
|--|---|
| Project Introduction | 1 |
| Primary U.S. Work Locations and Key Partners | 1 |
| Project Transitions | 2 |
| Images | 2 |
| Organizational Responsibility | 2 |
| Project Management | 2 |
| Technology Maturity (TRL) | 2 |
| Technology Areas | 3 |
| Target Destinations | 3 |

Gust Load Estimation and Rejection With Application to Robust Flight Control Design for HALE Aircraft, Phase I

Completed Technology Project (2015 - 2016)



| Organizations Performing Work | Role | Type | Location |
|--|-------------------------|-------------|---------------------|
| Systems Technology, Inc | Lead Organization | Industry | |
| ● Armstrong Flight Research Center(AFRC) | Supporting Organization | NASA Center | Edwards, California |
| University of Michigan-Ann Arbor | Supporting Organization | Academia | Ann Arbor, Michigan |

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Systems Technology, Inc

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Brian P Danowsky

Project Transitions

▶ **June 2015:** Project Start

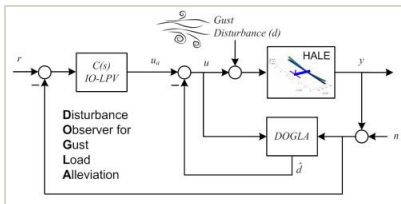
✓ **June 2016:** Closed out

Closeout Summary: Gust load estimation and rejection with application to robust flight control design for HALE aircraft, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image(<https://techport.nasa.gov/file/139035>)

Images

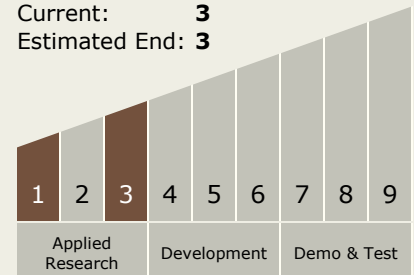


Briefing Chart Image

Gust load estimation and rejection with application to robust flight control design for HALE aircraft, Phase I

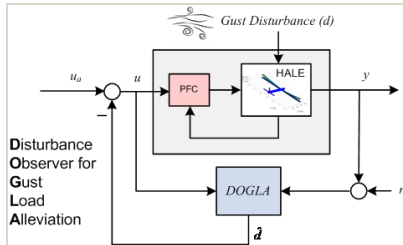
(<https://techport.nasa.gov/image/128769>)

Technology Maturity (TRL)

Start: **1**Current: **3**Estimated End: **3**

Gust Load Estimation and Rejection With Application to Robust Flight Control Design for HALE Aircraft, Phase I

Completed Technology Project (2015 - 2016)



Final Summary Chart Image

Gust load estimation and rejection with application to robust flight control design for HALE aircraft, Phase I Project Image
(<https://techport.nasa.gov/image/136053>)

Technology Areas

Primary:

- TX15 Flight Vehicle Systems
 - └ TX15.1 Aerosciences
 - └ TX15.1.3 Aeroelasticity

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System